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2003.01.17

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Fig. nr.

SAL Yoke System	Doc. no.: 042 - 01 0699 RE
Document Title: SAL Yoke System (SYS) General Technical Description	Page: 3 of 5
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1 SUMMARY AND CONCLUSIONS

A system for passively mooring large tankers in shallow water and simultaneous multi-pass fluid transfer is outlined and shown in DWG 042-AG-5-2594. The system is intended for FSO and FPSO project developments and uses APL's submerged turret system as a main element in order to obtain full rotational freedom combined with high regularity.

The turret swivel and mooring is based on the well proven single anchor loading (SAL) principles while the fluid transfer system is elevated above water through a tower structure.

The following main points have been focused in the design.

PATENTSTYRET

- Shallow water
- Large, passive tankers
- Dry trees and swivel
- Full rotational freedom

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The system is characterised by the following high-lights:

- Large capacity mooring in shallow water
- Large capacity fluid transfer
- Minimal ship conversions
- Full 360 deg rotation capacity
- Dry access to swivel
- Avoiding collision with layout of yoke and mooring
- Small tower well suited for ice conditions
- Low overturning moments from vessel loads
- Good flexibility for vessel wave frequency motions

2 INTRODUCTION

A need for a shallow water mooring and fluid transfer system has driven the development of the presented concept.

3 DEFINITIONS AND ABBREVIATIONS

APL Advanced Production and Loading AS

SAL Single Anchor Loading

SYS SAL Yoke System

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4 DESCRIPTION

4.1 General

The main parts of the system are

- Foundation
- Turret
- Mooring System
- Vessel connections
- Tower Structure
- Fluid transfer system

4.2 Foundation

The foundation is either suction or driven pile structure with a beam frame structure to transfer the forces from the turret to the soil.

4.3 Turret

The turret is a SAL-like turret with self-lubricated axial and radial bearings similar to the arrangement in all STL and SAL systems. A 3-5 m turret diameter is foreseen. The bearings are sliding bronze alloy bearings with PTFE lubrication (OILES 500).

4.4 Mooring System

The Mooring system consists of a Yoke fixed to the turret with joints to transfer vertical rotations but absorb rotations about the two horizontal axis. The Yoke is approximately 25 m long.

The yoke has a weight element at the outer end to provide softness into the mooring system.

At the end of the yoke chains or hinged beams transfer the loads from the vessel arranged also to stop the vessel from colliding with the tower. If chains are used, these are typ. 3-4" nominal size - design for the actual application.

A stopper can be provided for the yoke to avoid collision.

4.5 Vessel connections

The chain is connected with shackles to cantilever beams extending from the vessel side. The extension is to avoid scraping the chain against the vessel sides.

The flexible pipe connections are flanged to the ship-side piping. The flexibles are laid over a cradle structure to include required flexibility to the configuration.

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4.6 Tower Structure

The riser tower has several functions.

- Platform for swivel
- Container for piping
- Access to fluid transfer system

On deck also pull-in systems, navaids and pigging facilities can be arranged if required.

4.7 Fluid transfer system

The fluid transfer system includes the following:

- Piping through tower
- Fluid and utility swivels
- Flexibles from swivel outlet to vessel connection
- Swivel drive - arranged trough tower or driven by outlet flexibles
- Pigging facilities can be arranged on tower

4.8 Options

- There are different options on the swivel drive
- A gangway can be included instead of boat transfer of personnel

5 INSTALLATION

The system will typically be split in several phases:

- Install foundation including turret structure and pipe tie-back
- Install Yoke and chains
- Erect and bolt tower onto turret top
- Make up pipes
- Arrive with vessel, connect chains and pull-in flexibles
- System commissioning and testing

System and system installation is only outlined, but is flexible with respect to schedule, installation spread and field layout.

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6 OPERATION

The system will typically be passively operated. The system is designed for long term unattended service. All critical components are designed for lifetime, but still with easy inspection and possibilities for change-out.

7 DRAWINGS

042-AG-5-2594 SYS Arrangement



